SYLLABUS
Fall semester 2022-2023 academic years
on the educational program "Mechanics and energetics (7M05405)"

Discipline's code	Discipline's title	Independent work of students (IWS)	No. of hours per week			Number of credits	Independent work of student with teacher (IWST)
			Lectures (L)	Seminars (Sem)	Laboratory (Lab)		
	Applied problems of mechanics and energetics	5	15	30		7.5	4

Academic course information

Form of education	Type of course	Types of lectures	Types of practical training	Number of IWS	Form of final control
Offline	Theoretical	Auditory	solving exercises and considering applied problems	4	a written exam (offline)
Lecturer	Bakytnur Berdenova, PhD				
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Academic presentation of the course

Aim of course	Expected Learning Outcomes (LO) As a result of studying the discipline the undergraduate will be able to:	Indicators of LO achievement (ID) (for each LO at least 2 indicators)
The objective of the given course is to give students a reasonable overview of mechanics and energetics problems, introduce with basic concepts and terms of energy conversion, transport and storage. Also familiarize them with the axioms, hypotheses and modern approaches in solving energetics problems. Much of the material of this module will be discussed in greater detail.	**LO 1 -** Knows the main concepts and terms of energetics, thermal properties of materials	**ID 1** – Problem Statement **ID 2** – Closure Models/Assumptions
	LO 2 - Describes the physical nature of energy transfer and conversion	**ID 1** – Thermal conductivity **ID 2** – Heat convection **ID 3** – Radiation
	LO 3 - Introduced with governing equations and can apply for solving problems	**ID 1** – Composite materials **ID 2** – Thermal resistance networks **ID 3** – Radial and spherical systems ID 4 – Shape factor
	LO 4 – Application of phase change materials	**ID 1** – Latent heat **ID 2** – Boiling and condensation
	LO 5 – Thermo-hydraulic analysis of energy systems	**ID 1** – Extended surface heat transfer **ID 2** – Fin efficiency **ID 3 –** Optimization problems
	LO 6 – Familiar with conventional and unconventional sources of energy	**ID 1 –** Conventional sources **ID 2 –** Unconventional sources
Prerequisites	1. Equations of mathematical physics 2. Continuum mechanics 3. Fluid mechanics 4. Thermodynamics and basics of heat and mass transfer	
Post requisites		
Information resources	**literature**: **Main:** 1. Fundamentals of heat and mass transfer. Theodore L. Bergman, Adrienne S. Lavine, Frank P. Incropera, David P. Dewitt, ISBN 13 978-0470-50197-9, 2011. 2. Design of fluid thermal systems, William S. Janna 3. Сборник задач по технической термодинамике, Д.Л. Жуховицкий. Учебное пособие,	

	Ульяновск, 2004. 4. J.Bear, A. Verruijt. Modeling Groundwater Flow and Pollution. Holland.: Reidel Publishing Company, 1990 – 414 pp. 5. J.Bear. Dynamics of Fluids in Porous Media. USA, 2014 6. Tarek Ahmed. Reservoir Engineering. USA, 2011 7. Полубаринова-Кочина П.Я. Теория движения грунтовых вод. М.: Наука, 1977. – 664 стр. 8. Коллинз Р. Течение жидкостей через пористые материалы. Мир: - 1964. 9. Шестаков В.М. Динамика подземных вод. Изд-во Московского университета, 1979 г. 10. Zoltan E. Heinemann. Textbook series; Volume1: Fluid flow in porous media. Leoben, 2005 – 204 pp. **Additional:** 1. Берденова Б.А., Туралина Д.Е., Comsol Multiphysics бағдарламалық пакетін қолдану бойынша зертханалық жұмыстар, оқу-әдістемелік құрал, Қазақ университеті, Алматы, 2021. 2. Чарный И.А. Подземная гидрогазодинамика. М.:1963 3. L. Dake, Fundamentals of Reservoir Engineering, Elsevier, 1978. 4. K. Aziz and A. Settari, Petroleum Reservoir Simulation, 1979. 5. F. Dullien, Porous Media: Fluid Transport and Pore Structure, Second Edition, Academic Press, 1992. 6. R. Probstein, Physico-Chemical Hydrodynamics, Wiley, 1994.
Academic policy of the course in the context of university moral and ethical values	**Academic Behavior Rules:** All students have to register at the MOOC. The deadlines for completing the modules of the online course must be strictly observed in accordance with the discipline study schedule. ATTENTION! Non-compliance with deadlines leads to loss of points! The deadline of each task is indicated in the calendar (schedule) of implementation of the content of the curriculum, as well as in the MOOC. **Academic values:** - Practical trainings/laboratories, IWS should be independent, creative. - Plagiarism, forgery, cheating at all stages of control are unacceptable. - Students with disabilities can receive counseling at e-mail *******@gmail.com.
Evaluation and attestation policy	**Criteria-based evaluation:** assessment of learning outcomes in relation to descriptors (verification of the formation of competencies in midterm control and exams). **Summative evaluation:** assessment of work activity in an audience (at a webinar); assessment of the completed task.

CALENDAR (SCHEDULE) THE IMPLEMENTATION OF THE COURSE CONTENT:

weeks	Topic name	LO	ID	amount of hours	Maximum score	Form of Knowledge Assessment	The Form of the lesson / platform
Module **1**							
1	**L.1** Introduction. Basic modes of heat transfer. Units, definitions, Energy, Power, Rate of heat transfer	LO 1	ID 1.1.	1			Auditory
	Sem.1 Problems solving	LO 1	ID 1.1.	2		Analysis	Auditory
2	**L.2** Thermal conductivity for various materials, heat transfer coefficient, Specific heat capacity, Field of temperature distribution	LO 1	ID 1.1.	1			Auditory
	Sem.2 Problems solving	LO 1	ID 1.1.	2	10	Analysis	Auditory
	IWS 1. Review of thermal power plants (on coal, wood, natural gas etc.), Nuclear power stations. Hydro energy stations.	LO 1	ID 1.1.				Auditory
3	**L.3** Heat diffusion equation, thermal diffusivity, volumetric phenomenon - energy generation term, the first law of thermodynamics.	LO 1	ID 1.1.	1			Auditory
	Sem.3 Problems solving	LO 1	ID 1.1.	2	10		Auditory
4	**L.4** Radiation heat transfer, Heat convection, convective heat transfer coefficient. The thermal	LO 3	ID 3.1.	1			Auditory

	resistance concept						
	Sem.4 Problems solving	LO 1	ID 1.1.	2	10		Auditory
	IWSP 1. Receiving reports and listens to student's presentation on *IWS 1*. Consultation on the implementation of *IWS 2.* **ISW 2.** Energy accumulation, solar collectors. Heat pumps. Cooling systems.	LO 4	ID 4.1.		20	Students give presentation on the theme of *IWS 1* + written report (at least 1500 words)	Auditory
5	**L.5** Steady state heat transfer. Thermal resistance network. Composite materials.	LO 4	ID 4.1.	1			Auditory
	Sem.5 Problems solving	LO 1	ID 1.1.	2	10		Auditory
6	**L.1** Heat transfer in radial and spherical systems. Conduction shape factor	LO 1	ID 1.1.	1			Auditory
	Sem.1 Problems solving	LO 1	ID 1.1.	2	10	Analysis	Auditory
7	**L.7** Multi-dimensional Steady State Heat Conduction, Conduction shape factor	LO 1	ID 1.1.	1			Auditory
	Sem.1 Control work.	LO 5	ID 5.1.	2	30	Analysis	Auditory
	RK 1 - 1 Midterm Assessment				**100**		
8	**L.8** Extended Surface Heat Transfer, Fin Efficiency	LO 1	ID 1.1.	1			Auditory
	Sem.8 Problems solving	LO 1	ID 1.1.	2		Analysis	Auditory
	IWSP 2. Receiving reports and listens to student's presentation on *IWS 2*. Consultation on the implementation of *IWS 3* **ISW 3.** Energy of chemical reactions, galvanic cell, battery. Renewable Energy: wind, biomass, algae biofuels etc.	LO 1	ID 1.1.		10	Students give presentation on the theme of *IWS 2* + written report	Auditory
9	**L.9** Biot number. Unsteady heat conduction.	LO 1	ID 1.1.	1			Auditory
	Sem.9 Problems solving	LO 1	ID 1.1.	2	10	Analysis	Auditory
10	**L.10** Fourier number. Lumped thermal capacity model.	LO 1	ID 1.1.	1			Auditory
	Sem.10 Problems solving	LO 1	ID 1.1.	2	10	Analysis	Auditory
	ISW 4. Compose 5 test questions with 5 answers					Hard and soft copies	
11	**L.11** Energy balance equation. Finite difference methods: explicit and implicit formulations. Heat transfer in fluids.	LO 1	ID 1.1.	1			Auditory
	Sem.11 Problems solving	LO 1	ID 1.1.	2	10	Analysis	Auditory
12	**L.12** Heat transfer in fluids. Heat exchangers, Thermo-Hydraulic Analysis of energy systems.	LO 1	ID 1.1.	1			Auditory
	Sem.1 Problems solving	LO 1	ID 1.1.	2		Analysis	Auditory
	IWSP 3 Receiving reports and listens to student's presentation on *IWS 3.* Consultation on the implementation of *IWS 5* **ISW 5.** Prandtl, Nusselt, Reynolds numbers	LO 1	ID 1.1.		15	Students give presentation on the theme of *IWS 3* + written report	Auditory
13	**L.13** Boiling and Condensation. Latent heat, phase change materials.	LO 1	ID 1.1.	1			Auditory
	Sem.13 Problems solving, Test *ISW 4*.	LO 1	ID 1.1.	2	10	Analysis	Auditory
14	**L.14** Energy storage and transportation problems, energy losses	LO 1	ID 1.1.	1			Auditory
	Sem.14 Control work	LO 1	ID 1.1.	2	25	Analysis	Auditory
15	**L.15** Conventional and unconventional sources of	LO 1	ID 1.1.	1			Auditory

	energy						
	Sem.15 Problem solving	LO 1	ID 1.1.	2		Analysis	Auditory
	IWSP 4. Receiving reports and listens to student's presentation on *IWS 5*	LO 5	ID 5.1.		10	Students give presentation on the topic of *IWS 5* + written report	Auditory
	MT 2 - 2 Midterm Assessment				**100**		

[Abbreviations: QS - questions for self-examination; TK - typical tasks; IT - individual tasks; CW - control work; MT - midterm.

Comments:

- Form of L and PT: webinar in MS Teams / Zoom (presentation of video materials for 10-15 minutes, then its discussion / consolidation in the form of a discussion / problem solving / ...)
- Form of carrying out the CW: webinar (at the end of the course, the students pass screenshots of the work to the monitor, he/she sends them to the teacher) / test in the Moodle DLS.
- All course materials (L, QS, TK, IT, etc.) see here (see Literature and Resources, p. 6).
- Tasks for the next week open after each deadline.
- CW assignments are given by the teacher at the beginning of the webinar.]

Dean **Abdibekov U.S.**

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